Cambridge Assessment International Education

Cambridge International AS & A Level

BIOLOGY **9700/11**

Paper 1 Multiple Choice **October/November 2022**

1 hour 15 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
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- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

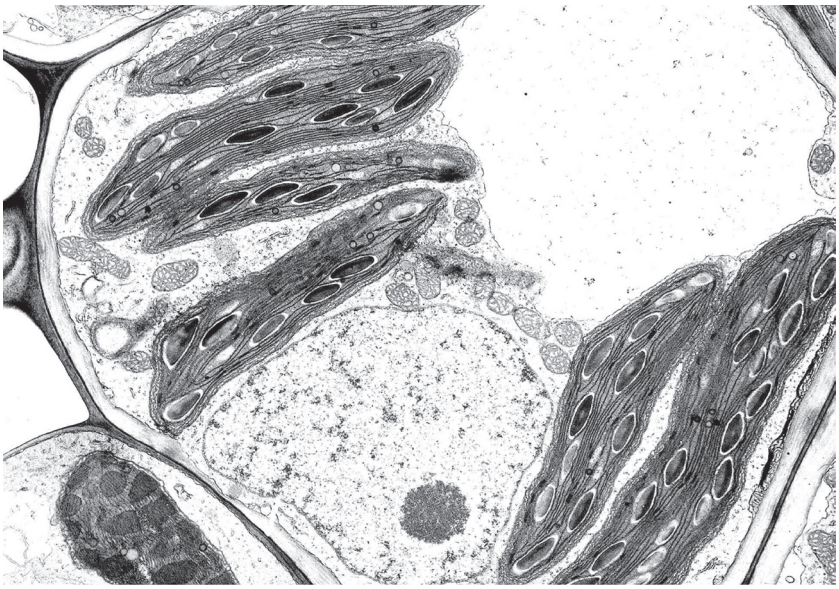
INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.

This document has **16** pages.

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1 The photomicrograph shows part of a plant cell.



What is the magnification of the cell?

A ×250 **B** ×400 **C** ×1000 **D** ×4000

2 Which row matches each organelle with its function?

	microtubules	rough endoplasmic reticulum	Golgi body	centrioles
A	make cilia and spindle	separates some processes from cytoplasm	makes lysosomes	assemble the spindle during nuclear division
B	move vesicles within the cell	assembles amino acids to make proteins	contains enzymes for destroying worn out parts of the cell	move chromosomes apart during anaphase
C	move chromatids apart during anaphase	modifies proteins which may be released from cell	makes glycoproteins	move cilia
D	form part of the cytoskeleton	makes triglycerides and phospholipids	modifies proteins by adding carbohydrates	move individual cells

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3 Where are 80S ribosomes found?

1 chloroplasts

2 cytoplasm of eukaryotes

3 mitochondria

4 cytoplasm of prokaryotes

A 1, 2 and 3 **B** 1 and 3 only **C** 2 only **D** 4 only

4 Which feature, when present in an organism, enables it to be identified as a prokaryote?

A cytoplasmic DNA

B cell wall

C nucleus

D ribosomes

5 What is the function of the nucleolus?

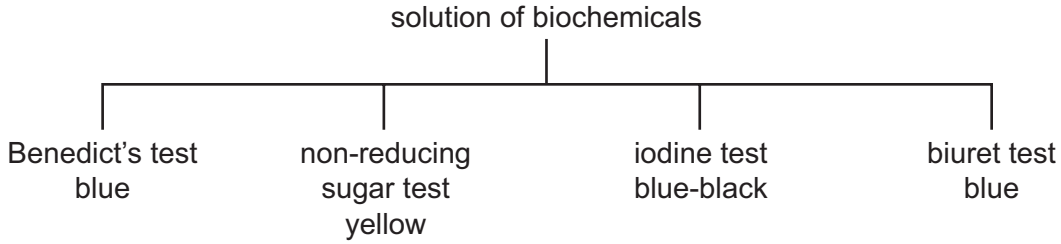
A the formation and breakdown of the nuclear envelope

B the formation of rough endoplasmic reticulum

C the synthesis of ribosomal proteins

D the synthesis of rRNA

6 The diagram shows the results of a number of tests on a solution of biochemicals.



Which substances are present in the solution?

A non-reducing sugar and starch only

B protein, non-reducing sugar and starch

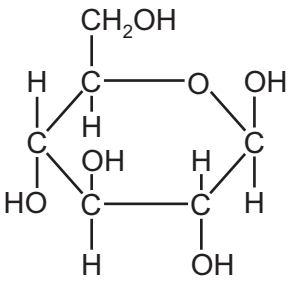
C starch and reducing sugar

D starch only

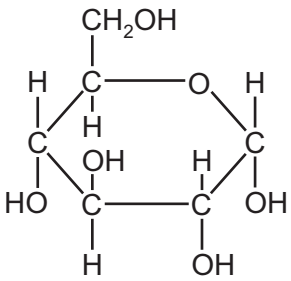
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7 Which diagram shows the ring form of β-glucose?

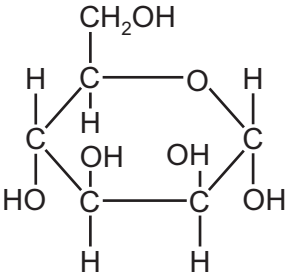
A



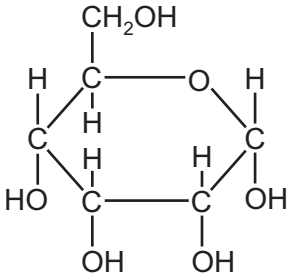
B



C



D



8 Which row correctly matches the example with the type of molecule?

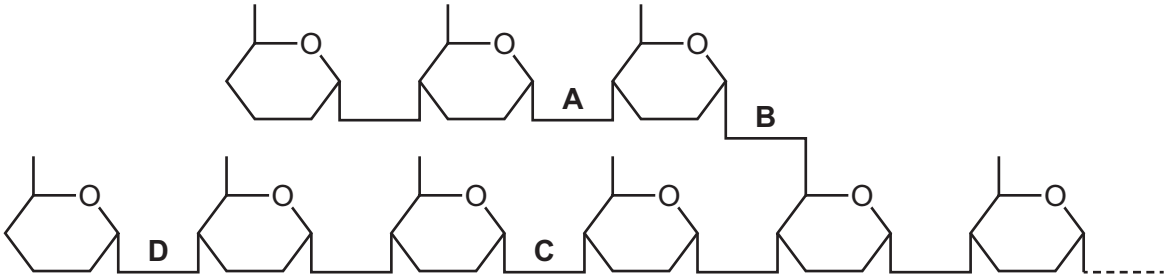
	disaccharide	macromolecule	monomer	polymer
A	fructose	glycogen	glucose	starch
B	starch	haemoglobin	ribose	glycogen
C	maltose	ribonucleic acid	sucrose	cellulose
D	sucrose	cellulose	fructose	collagen

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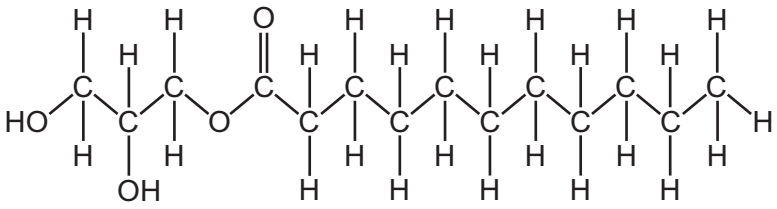
9 The enzyme α-amylase hydrolyses amylopectin but it is not able to hydrolyse some of its glycosidic bonds.

- It only hydrolyses 1,4 glycosidic bonds.
- It is not able to hydrolyse the last bond of a chain.
- It is not able to hydrolyse the bonds in a chain of three units attached by a 1,6 glycosidic bond to another chain.

Which glycosidic bond can be hydrolysed by α-amylase?



10 Molecule X is a lipid.



molecule X

Which row is correct for molecule X and a triglyceride?

	molecule X contains	triglyceride contains
A	one unsaturated fatty acid	saturated fatty acids
B	no ester bonds	three ester bonds
C	one fatty acid	three fatty acids
D	two fatty acids	three fatty acids

11 Bread contains a mixture of polypeptides known as gluten.

Two of the polypeptides found in gluten are glutenin and gliadin.

Which statement describes the tertiary structure of a protein?

A Disulfide bonds form between glutenin and gliadin.

B A large proportion of the amino acids in gliadin are glutamine.

C α-helical sections are found in glutenin and gliadin.

D Amino acids with hydrophobic R groups are found on the inside of glutenin.

12 A student was provided with two test-tubes, one containing $10\,cm^3$ of solution P and one containing $10\,cm^3$ of solution Q. When these solutions were mixed together and left for 24 hours, the concentration of P decreased but the concentration of Q remained the same.

The student wrote the following conclusions.

1 P may break down over time.

2 Q may be a biological catalyst.

3 P may be the substrate for Q.

Which conclusions could be supported by the information?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 only **D** 2 and 3 only

13 Which statements are correct for the lock and key hypothesis **and** the induced fit hypothesis of enzyme action?

1 The substrate is the same shape as the active site.

2 The substrate is held in place in the active site by temporary bonds.

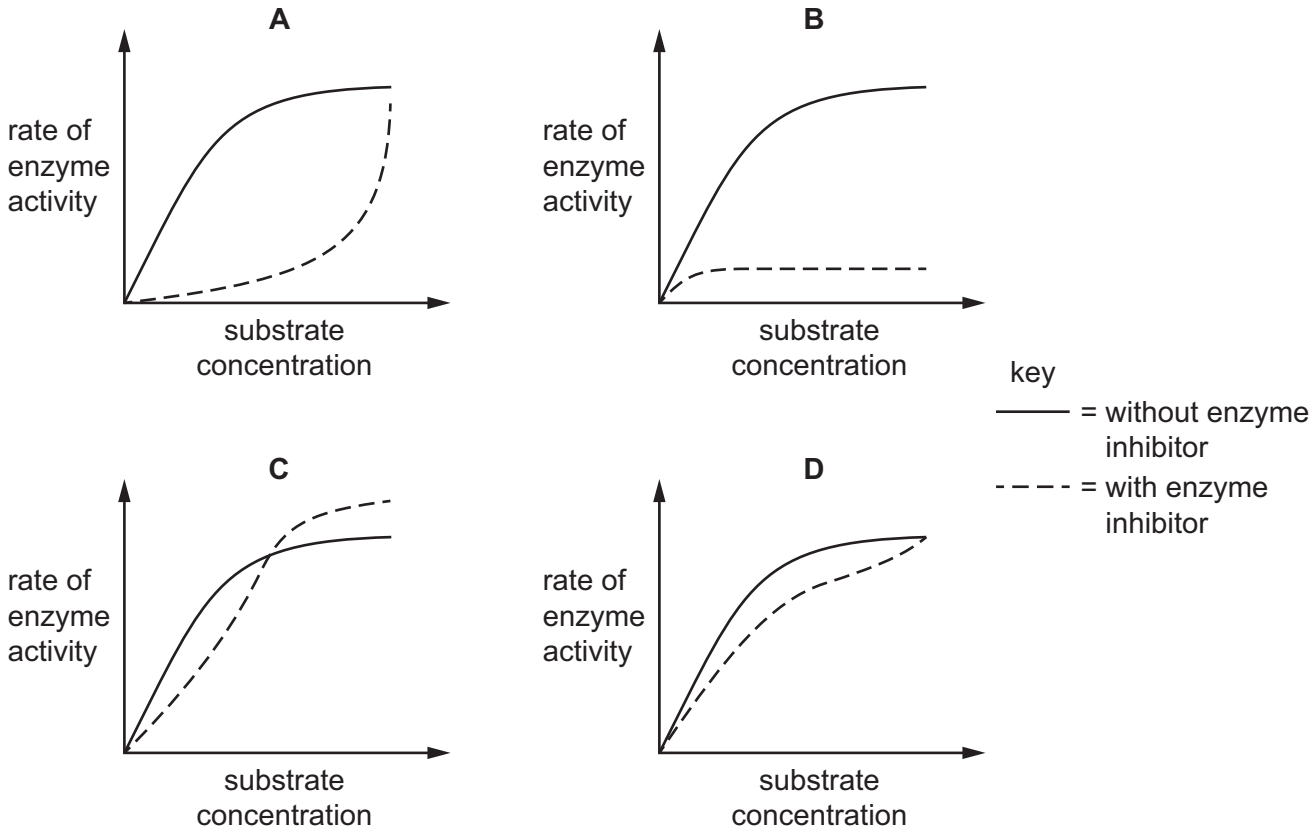
3 The enzyme and sometimes the substrate change shape slightly as the substrate molecule enters the enzyme.

A 1 and 2 **B** 1 and 3 **C** 2 only **D** 3 only

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14 A student investigated the rate of enzyme activity with increasing substrate concentration. The experiment was repeated with the addition of a reversible non-competitive enzyme inhibitor. A graph was plotted to show the results.

Which graph represents the results of the two experiments?



15 A cuboidal epithelium cell has a length of 2 μm.

The cell is an approximate cube shape.

What is the most accurate estimate of the surface area : volume ratio of this cuboidal epithelium cell?

A 1 : 2 **B** 1 : 3 **C** 2 : 1 **D** 3 : 1

16 Which statement is correct for facilitated diffusion **and** active transport?

A As the direction of the concentration gradient changes so does the direction of movement of the molecules.

B Molecules always move at the same rate as simple diffusion.

C Specific molecules are transported across a membrane.

D The molecule ATP is required to move specific molecules quickly through proteins in the membrane.

17 Equal sized potato pieces were placed into a test-tube and covered with a sucrose solution. The test-tube was left for 30 minutes. All other variables were standardised.

After 30 minutes, the potato piece had not changed in size.

What can be concluded from this result?

A The concentration of sucrose is the same in the potato and in the solution and there is no more movement of water into or out of the potato.

B The concentration of sucrose is the same in the potato and in the solution and there is no net movement of water into the potato.

C The water potential is the same in the potato and in the sucrose solution and there is no more movement of water into or out of the potato.

D The water potential is the same in the potato and in the sucrose solution and there is no net movement of water into or out of the potato.

18 How many of these processes produce genetically identical cells?

- growth of plant roots
- replacement of dead human skin cells
- repair of damaged muscle tissue
- asexual reproduction of coral

A 1 **B** 2 **C** 3 **D** 4

19 Which row shows the correct number of each component of a single chromosome at the end of prophase of mitosis?

	centromeres	chromatids	polynucleotide strands	telomeres
A	1	0	2	2
B	1	2	4	4
C	2	0	4	2
D	2	2	2	4

20 Which processes occur during interphase?

1 DNA replication

2 microtubule organisation

3 synthesis of ribosomes

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

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21 Embryonic stem cells are able to replicate continuously.

What happens to the telomeres during repeated mitotic cell cycles of embryonic stem cells?

A Their lengths increase.

B Their lengths decrease.

C They are completely lost.

D They stay the same length.

22 Which nitrogenous bases are pyrimidines?

A adenine and thymine

B cytosine and guanine

C thymine and uracil

D uracil and guanine

23 DNA replication in bacteria was investigated. Bacteria were grown in a medium with only heavy nitrogen, ^{15}N, until all of the bacterial DNA was heavy.

These bacteria were moved from the heavy nitrogen medium and cultured in a medium with only light nitrogen, ^{14}N. This formed the first generation.

The bacteria continued to reproduce, and a sample of bacteria was collected from the second generation and the DNA analysed.

Hybrid DNA contains heavy and light DNA.

Which row is correct for the second generation?

	percentage of heavy DNA strands	percentage of hybrid DNA molecules
A	25	25
B	25	50
C	50	25
D	50	50

24 The sequence shows the series of bases at the start of a gene.

TAC CGA CCA CCA CAA CCA CGA...

After transcription, the mRNA was translated via tRNA into a sequence of amino acids. When this part of the polypeptide was analysed, it was found to contain the amino acids in the table.

amino acid	number present
Ala	2
Gly	3
Met	1
Val	1

What is the sequence of amino acids in this part of the polypeptide?

A Met Ala Gly Ala Gly Gly Val

B Met Ala Gly Gly Val Gly Ala

C Met Gly Ala Ala Val Ala Gly

D Met Gly Ala Ala Gly Gly Val

25 The table shows the mode of action of two antibacterial drugs that can affect the synthesis of proteins.

antibacterial drug	rifampicin	streptomycin
mode of action	binds to RNA polymerase	causes errors in translation

If bacteria are treated with the drugs rifampicin **and** streptomycin, what will be the immediate effects?

1 Transcription will stop but faulty proteins may continue to be synthesised.

2 If translation has started, proteins may be faulty.

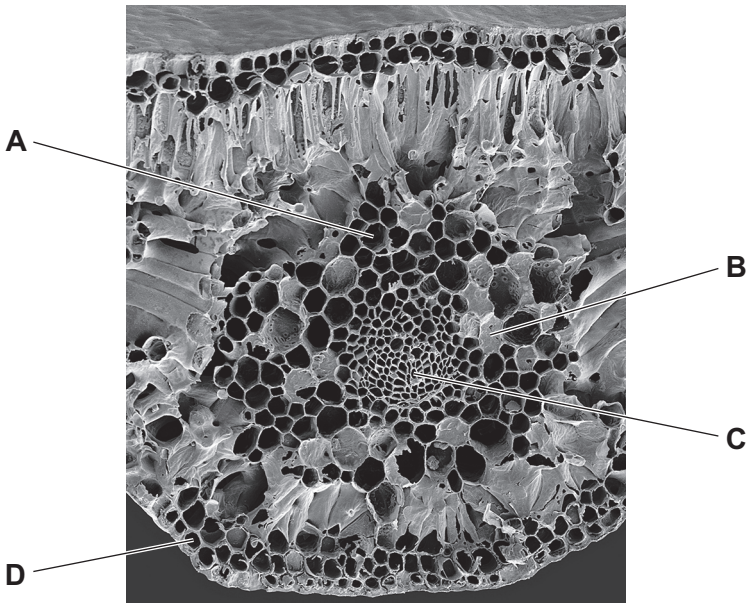
3 Translation will be inhibited.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

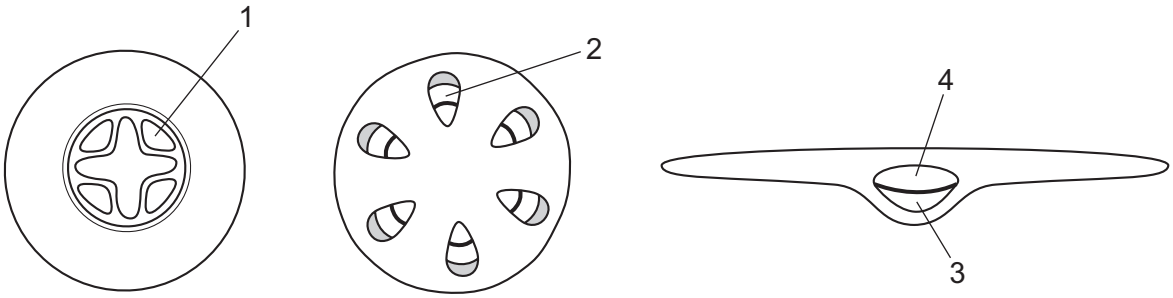
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26 The electron micrograph shows a cross-section of a leaf vein and some neighbouring cells.

Which structure contributes to mass flow by the use of proton pumps?



27 The diagrams show some tissue types in plant organs.



Which row identifies the tissue types?

	1	2	3	4
A	phloem	phloem	phloem	xylem
B	phloem	xylem	phloem	xylem
C	xylem	phloem	xylem	phloem
D	xylem	xylem	phloem	xylem

28 Which description of xylem vessel elements is correct?

A cells joined to form a tube, pits at intervals, sieve plates between cells, surrounded by the endodermis in roots

B contains cells joined end to end, containing cytoplasm, cell walls with lignin, located to the outside of phloem in vascular bundles

C contains elongated cells with end walls broken down, located in vascular bundles in the stem and leaves

D dead elongated cells, lignified cell walls with pits at intervals, associated with companion cells in the roots only

29 Which properties of lignin are important for the function of xylem vessels in the stem of a tall plant, such as a tree?

1 It is inflexible so does not bend easily.

2 It is not permeable to water.

3 It is strong to resist collapse under pressure.

4 It has weaker adhesion to water molecules than cellulose.

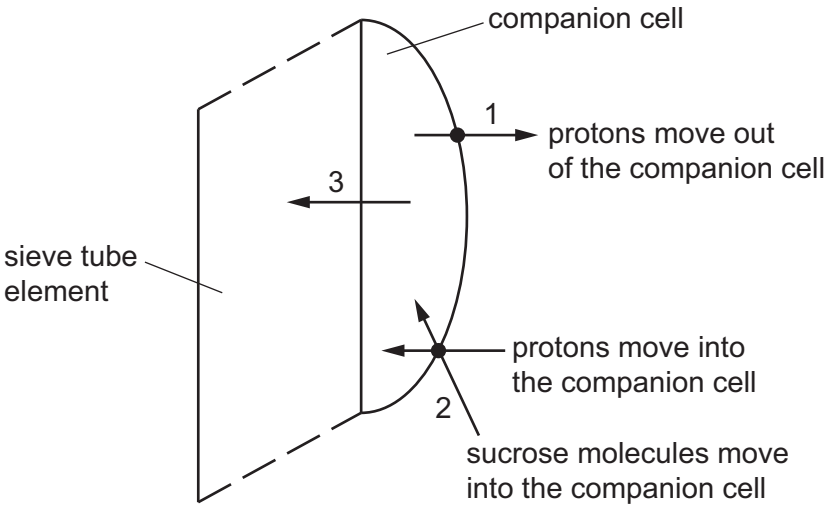
A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

30 Which row is correct for the sucrose concentrations and the water potentials in a source and a sink in a potato plant, at 12:00 p.m.?

	sucrose concentration		water potential	
	source	sink	source	sink
A	higher	lower	higher	lower
B	higher	lower	lower	higher
C	lower	higher	higher	lower
D	lower	higher	lower	higher

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31 The diagram shows one possible way in which sucrose may be loaded into a sieve tube element.



Which steps require ATP?

A 1 and 2 **B** 1 and 3 **C** 1 only **D** 3 only

32 Which statements about arteries are correct?

1 Artery walls can resist high pressure.

2 Arteries pump blood out of the heart.

3 Blood in arteries has the same flow rate as in veins.

4 The pulse in arteries is the result of a surge in blood that causes expansion of the artery wall.

5 There are semilunar valves at the junction of arteries with the heart.

A 1, 2 and 4 **B** 1, 3 and 5 **C** 1, 4 and 5 **D** 2, 3 and 4

33 What happens during ventricular systole in a mammalian heart?

1 The atrioventricular node transmits an electrical signal to the apex of the heart.

2 The pressure in the ventricles drops below the pressure in the atria.

3 The atrioventricular valves close and the semilunar valves open.

A 1 and 2 **B** 1 and 3 **C** 2 only **D** 3 only

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34 A shortage of protein in the diet of children can lead to a disease that causes excess tissue fluid to build up in the abdomen.

What explains why a build-up of excess tissue fluid can occur in this disease?

A A shortage of plasma proteins decreases blood water potential; less tissue fluid returns to the blood.

B A shortage of plasma proteins increases blood water potential; less tissue fluid returns to the blood.

C A shortage of protein in the diet causes weak cardiac muscle, reducing hydrostatic pressure.

D A shortage of protein in the tissue fluid decreases its water potential; more water leaves the blood.

35 Red blood cells may contain a molecule known as 2,3-bisphosphoglycerate (2,3-BPG).

When 2,3-BPG binds to haemoglobin, a higher partial pressure of oxygen is needed to bring about 50% saturation of haemoglobin with oxygen.

Which statements about the effect of 2,3-BPG are correct?

1 2,3-BPG in red blood cells causes the oxygen dissociation curve to shift to the right.

2 The binding of 2,3-BPG to haemoglobin reduces the Bohr effect.

3 The binding of 2,3-BPG to haemoglobin lowers the affinity of the haemoglobin for oxygen.

4 When 2,3-BPG is not present, oxyhaemoglobin is less likely to unload oxygen.

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 and 4

36 Carbon dioxide is continually produced by respiring cells. It diffuses into red blood cells and dissociates into hydrogen ions (H^+) and hydrogen carbonate ions (HCO_3^-). HCO_3^- then diffuses out of the cell in exchange for chloride ions (Cl^-) in the chloride shift.

What is the importance of the chloride shift?

A It helps to maintain a neutral pH in the red blood cell by acting as a buffer.

B It maintains a balance of positive and negative charge between the cell and the plasma.

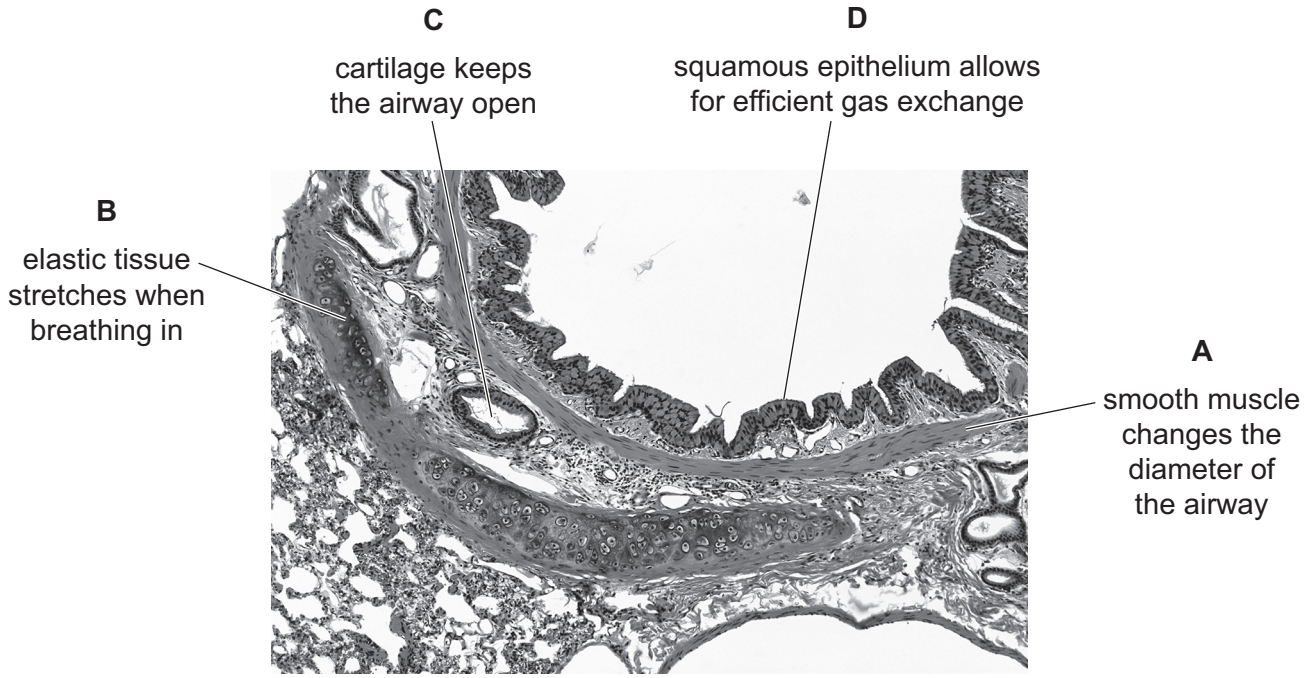
C It causes the oxygen dissociation curve to shift to the left, releasing more oxygen.

D It prevents carbon dioxide combining with haemoglobin, allowing haemoglobin to combine with oxygen.

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37 The photomicrograph shows a section through a bronchus.

Which annotated label is correct?



38 Penicillin is an antibiotic used to treat infections caused by bacteria.

Which events explain how bacteria become resistant to penicillin?

1 The number of bacteria with the allele for resistance to penicillin increases.

2 Resistance to penicillin is the result of a mutation in a bacterium.

3 Bacteria with the allele for resistance to penicillin pass the allele to their daughter cells.

4 The mutation for resistance to penicillin is always caused by the presence of penicillin.

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1 and 4 only

D 2 and 3 only

39 Which statements explain why some vaccines can be taken by mouth but tuberculosis (TB) vaccine has to be injected?

1 Macrophages present antigens in vaccines to stimulate an immune response.

2 The TB antigens necessary to produce an immune response are proteins which would be digested in the stomach and small intestine.

3 There are no B-lymphocytes and T-lymphocytes in the stomach.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 only

40 A student wrote the following statements about the production of monoclonal antibodies.

Which statement is **not** correct?

A Non-self antigen is injected into a mammal.

B Plasma cells secrete the specific antibody in response to a non-self antigen.

C Selected hybridoma cells divide by mitosis to form a clone.

D T-lymphocytes are fused with cancer cells to form hybridoma cells.

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Cambridge International AS & A Level

BIOLOGY **9700/12**

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INSTRUCTIONS

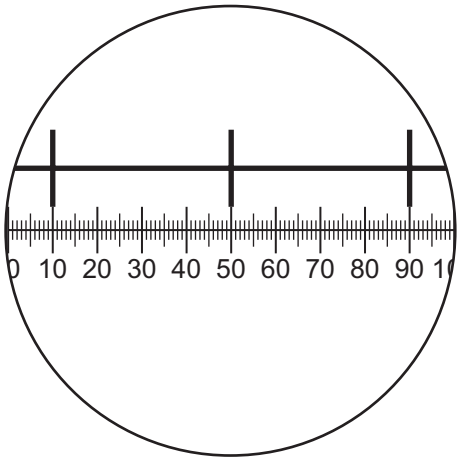
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1 The diagram shows a stage micrometer, with divisions 0.10 mm apart, viewed through an eyepiece containing a graticule.



The area of the field of view of the microscope can be calculated using this formula.

$$\text{area} = \pi r^2$$

A student calculated the area of the field of view of the microscope using the information provided and a value for π of 3.142.

Which answer has been rounded correctly to an appropriate number of significant figures?

A $0.04909\,\text{mm}^2$

B $5 \times 10^{-2}\,\text{mm}^2$

C $4.909 \times 10^{4}\,\mu\text{m}^2$

D $4.91 \times 10^{4}\,\mu\text{m}^2$

2 Where are cisternae found in a cell?

1 endoplasmic reticulum

2 Golgi body

3 mitochondria

A 1 and 2 **B** 1 and 3 **C** 1 only **D** 2 and 3

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3 Which row matches the functions to the cell structures?

	vacuole	nucleolus	ribosomes	lysosomes
A	stores water, sugar and pigment	manufactures messenger RNA	protein synthesis	involved in cell recognition
B	exports proteins	manufactures ribosomal RNA	lipid synthesis	involved in cell recognition
C	stores water, sugar and pigment	manufactures ribosomal RNA	protein synthesis	contains enzymes
D	exports proteins	manufactures messenger RNA	lipid synthesis	contains enzymes

4 Which structures are found in prokaryotes **and** eukaryotes?

A cell membrane and nucleus

B cell membrane and ribosomes

C nucleus and mitochondria

D mitochondria and ribosomes

5 Which molecules are present in all viruses?

1 thymine

2 adenine

3 cytosine

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

6 The table shows the observations recorded from tests for biological molecules on four samples, **A**, **B**, **C** and **D**.

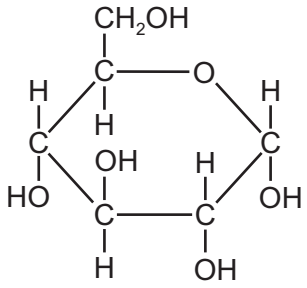
Which conclusion is correct?

	Benedict's solution	biuret reagent	iodine solution	conclusion
A	blue	blue	blue-black	contains starch only
B	blue	purple	orange	contains reducing sugar only
C	green	blue	orange	contains reducing sugar and protein
D	red	blue	blue-black	contains starch and protein

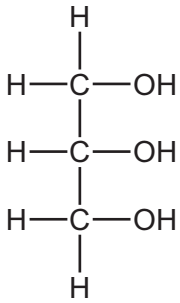
7 The diagrams show some biological molecules.

Which biological molecule forms a polymer with a structural role in plants?

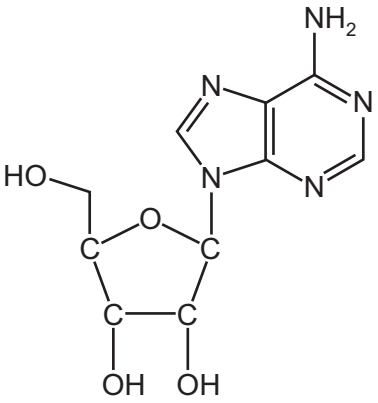
A



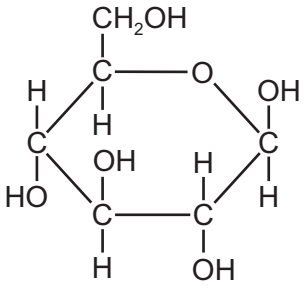
B



C



D



8 Which molecule is a disaccharide **and** a reducing sugar?

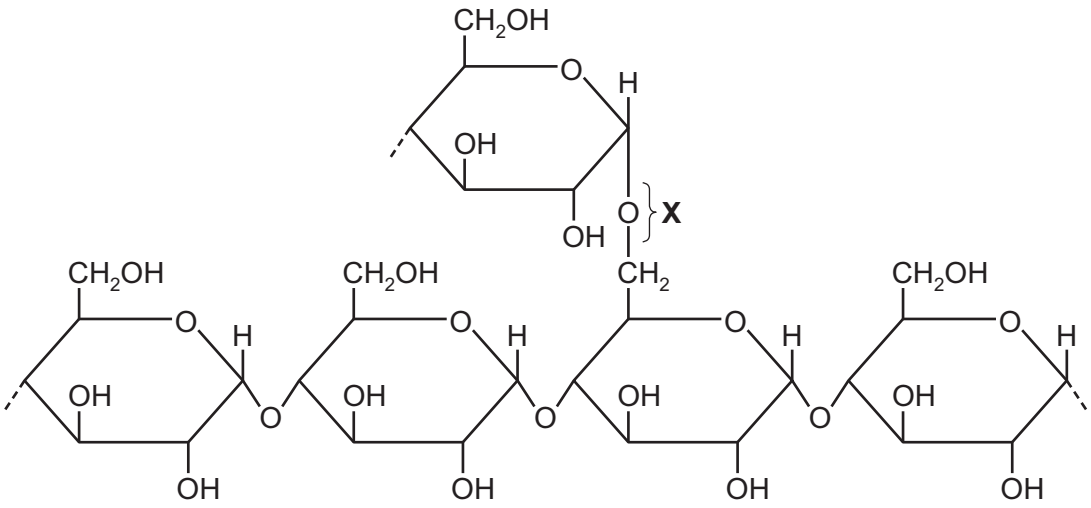
A fructose

B glucose

C maltose

D sucrose

9 The diagram shows bonding in part of a polysaccharide.



Which type of glycosidic bond is shown at position **X**?

A α-1,4 **B** α-1,6 **C** β-1,4 **D** β-1,6

10 Which statements about triglycerides **and** phospholipids are correct?

1 Fatty acids in a triglyceride may be saturated or unsaturated but in a phospholipid they are always saturated.

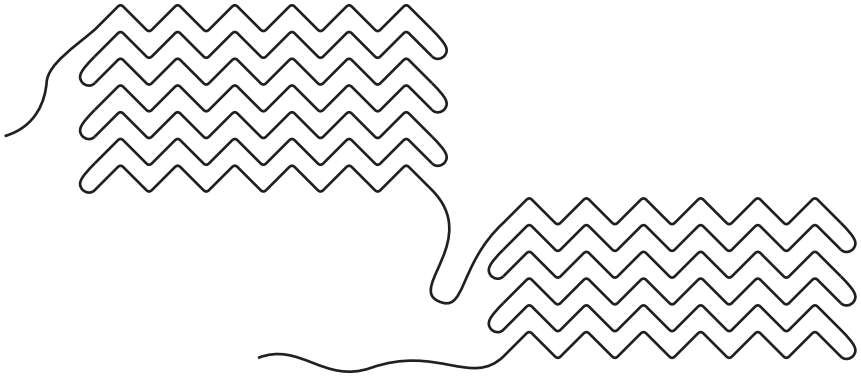
2 Triglycerides and phospholipids both have a hydrophobic region.

3 Triglycerides are non-polar molecules and phospholipids are polar molecules.

A 1 and 2 **B** 1 only **C** 2 and 3 **D** 3 only

11 Silk moth caterpillars have been genetically modified to produce a mixture of their own silk and the much stronger spider silk of the golden orb web spider.

The spider silk polypeptide chain has many repeated sequences of two amino acids, glycine and alanine, arranged in a crystalline structure.



What correctly describes the structure of spider silk?

A primary protein structure with regions of α-helices

B secondary protein structure with regions of β-pleated sheets

C tertiary protein structure with regions of α-helices

D quaternary protein structure with regions of β-pleated sheets

12 Which property of the tertiary structure of a globular protein enables it to catalyse a metabolic reaction?

A It has hydrophobic amino acid R groups on the outside.

B It will be denatured by high temperatures.

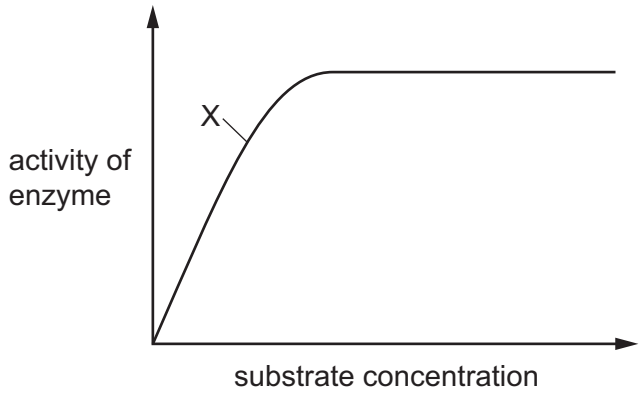
C The R groups of some amino acids form bonds with a substrate.

D The three-dimensional shape depends on hydrogen bonding.

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13 A student investigated the effect of substrate concentration on the activity of an enzyme.

The graph shows the results of this investigation.



An increase in which factors could lead to a change in the activity of the enzyme at point X on the graph?

1 pH

2 substrate concentration

3 temperature

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

14 The Michaelis–Menten constant, K_m, is the substrate concentration at which an enzyme works at half its maximum rate.

What is correct when the K_m value is low?

A The enzyme has a low affinity for the substrate and the quicker the reaction will proceed to its maximum rate.

B The enzyme has a low affinity for the substrate and the slower the reaction will proceed to its maximum rate.

C The enzyme has a high affinity for the substrate and the quicker the reaction will proceed to its maximum rate.

D The enzyme has a high affinity for the substrate and the slower the reaction will proceed to its maximum rate.

15 Which functions are performed by glycoproteins on the surface of a cell surface membrane?

1 to act as enzymes catalysing reactions in the membrane

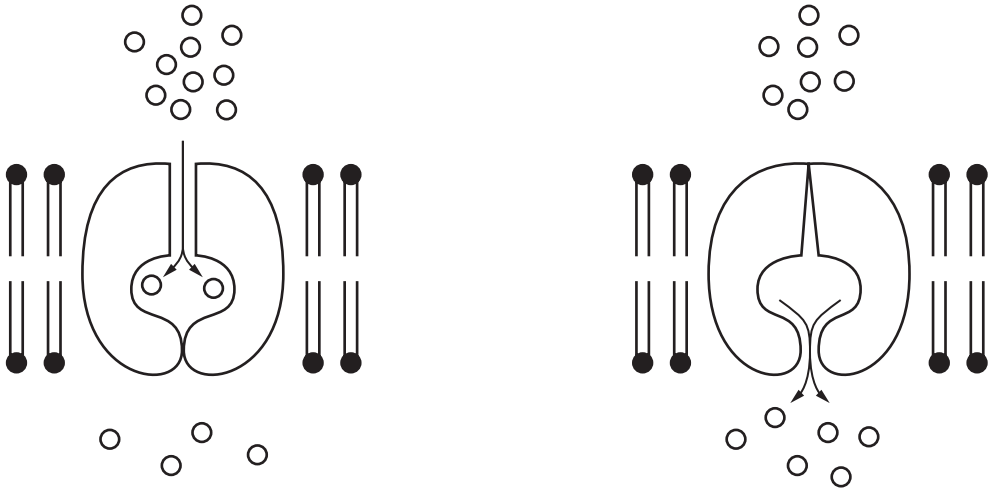
2 to have a specific site where chemicals can bind

3 to secrete specific chemicals used for cell signalling

A 1, 2 and 3 **B** 2 and 3 only **C** 2 only **D** 3 only

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16 The diagram represents a process by which molecules move out of a cell through a cell surface membrane.



Which process does this represent?

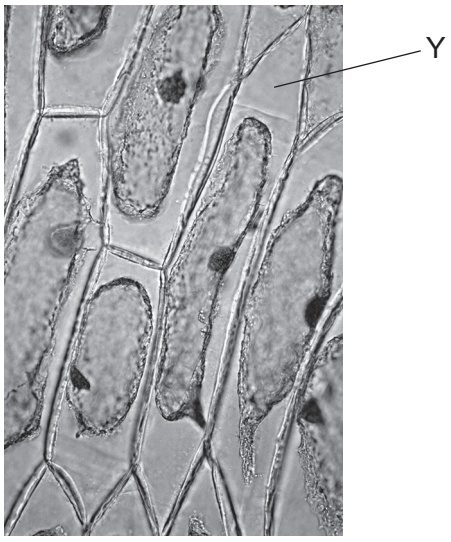
A exocytosis

B diffusion

C facilitated diffusion

D osmosis

17 The photomicrograph shows the appearance of onion epidermal cells after they have been soaked in solution X for one hour.



What fills the space labelled Y?

A air

B cytoplasm

C solution X

D water

18 The enzyme telomerase prevents loss of telomeres after many mitotic cell cycles.

Which cells need to transcribe telomerase enzyme?

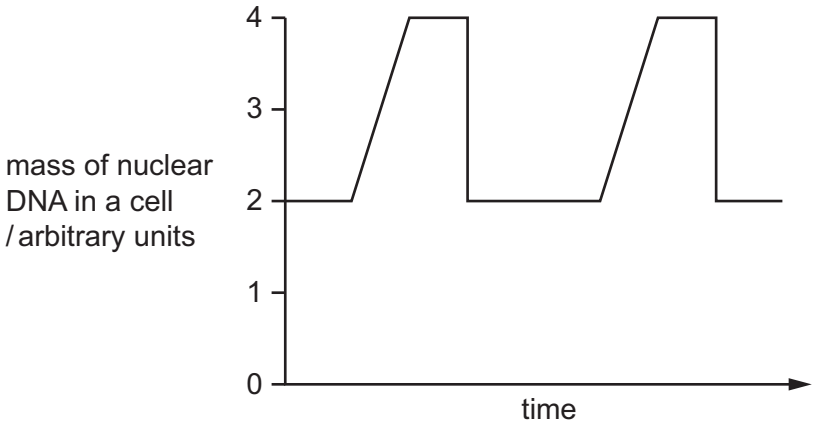
1 cancer cells

2 stem cells

3 activated memory B-lymphocytes

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

19 Which processes that occur in the cell cycle are represented in the diagram?



A DNA replication and nuclear division only

B DNA replication, nuclear division and cytokinesis

C mitosis and cytokinesis

D mitosis only

20 A gene codes for the production of a protein, p53, that binds to damaged DNA during interphase and prevents its replication. A carcinogen in cigarette smoke mutates the gene coding for the p53 protein, preventing production of the protein.

Which statement explains why this mutation may cause cancer?

A Cells with no p53 are able to undergo mitosis.

B Cells with no p53 replicate their damaged DNA.

C The carcinogen in cigarette smoke increases the rate of cell division.

D The mutated p53 causes uncontrolled cell division.

21 Stained onion cells undergoing mitosis were observed using a microscope.

Which row is correct for mitosis in plant cells?

	prophase	metaphase	anaphase	telophase
A	centrioles visible	chromosomes pair up at the equator	two telomeres are visible on each chromatid	two nuclear membranes form
B	centromeres present	chromosomes align at the equator	chromosomes replicate to form chromatids	centrioles disappear
C	each chromosome is visible as two chromatids	centromeres attach to spindle fibres	chromatids separate and migrate to opposite poles	chromosomes decondense
D	spindle fibres formed by centrioles	centromeres attach to spindle fibres	chromatids are pulled apart by centrioles	spindle fibres form new nuclear membranes

22 How many statements about semi-conservative replication of DNA in a eukaryotic cell are correct?

1 The process takes place in the cytoplasm.

2 An adenine nucleotide will line up against uracil on the template strand.

3 Each daughter molecule will contain half of the original DNA molecule.

4 If the DNA molecule contained 40% guanine nucleotides, each daughter molecule will contain 20% guanine nucleotides.

A 1 **B** 2 **C** 3 **D** 4

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23 A section of the polypeptide coding for the haemoglobin β-chain contains the following amino acids.

– Pro – Glu – Glu –

Patients with sickle cell anaemia have mutated β-polypeptide chains. The section of the mutated polypeptide contains the following amino acids.

– Pro – Val – Glu –

The table shows the possible anticodons for Val.

amino acid	anticodon
Val	C A A
Val	C A G
Val	C A C
Val	C A U

What is the corresponding DNA triplet code for the substituted amino acid in the mutated polypeptide?

A G T T **B** G A C **C** C T C **D** C A T

24 Which diagram correctly represents temporary hydrogen bonding during transcription?

A

A ------ U

B

C ------ G

C

G ------ C

D

T ------ U

25 The diagram shows part of the DNA sequence of a gene and a mutated sequence of the same gene.

normal DNA sequence ...CCG GAT TAT TGC GAG AAA TGG CAT TCT AGG...

mutated DNA sequence ...CCG GAT GTA TTG CGA GAA ATG CAT TCT AGG...

What are possible effects of the mutated sequence?

1 the presence of mRNA stop codons, UAG, UAA or UGA

2 a change in the sequence of amino acids

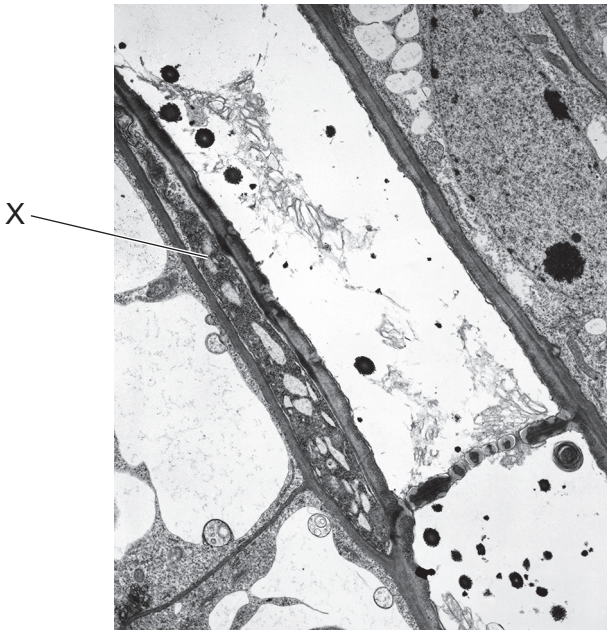
3 a non-functional protein

4 ribosomes cannot translate the mRNA

A 1, 2 and 3 **B** 1, 3 and 4 **C** 1 and 4 only **D** 2 and 3 only

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26 The electron micrograph shows a longitudinal section through part of a plant stem.



What is X?

A xylem vessel element

B stem cell

C phloem sieve tube element

D companion cell

27 Sodium chloride is added to a culture solution containing freshwater single-celled plant cells.

What happens to the water potential of the culture solution when the sodium chloride is added and what may happen to the plant cells after 5 minutes?

	water potential of the culture solution when sodium chloride added	single-celled plant cells after 5 minutes
A	becomes less negative	become plasmolysed
B	becomes less negative	become turgid
C	becomes more negative	become plasmolysed
D	becomes more negative	become turgid

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28 Which statements correctly describe transport pathways in dicotyledonous plants?

1 In the apoplast pathway, water may move through plasmodesmata.

2 In the symplast pathway, water may move through intercellular spaces.

3 The apoplast pathway may be blocked by the Casparian strip.

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 only

29 Which statement about the movement of water from roots to leaves is **not** correct?

A A continuous column of water is partly maintained by the attraction of water molecules to cellulose.

B Hydrogen bonding between water molecules enables mass flow of water.

C Hydrostatic pressure in xylem vessel elements is higher in roots than in leaves.

D Water potential changes throughout the length of the xylem vessel elements.

30 Which terms describe the method by which water is transported within xylem vessel elements?

1 cotransport

2 cohesion-tension

3 osmosis

A 1 and 2 **B** 1 and 3 **C** 2 only **D** 3 only

31 What is the main function of a companion cell in phloem tissue?

A providing cytoplasmic contact with the sieve tube element for loading

B providing structural support for the sieve tube element

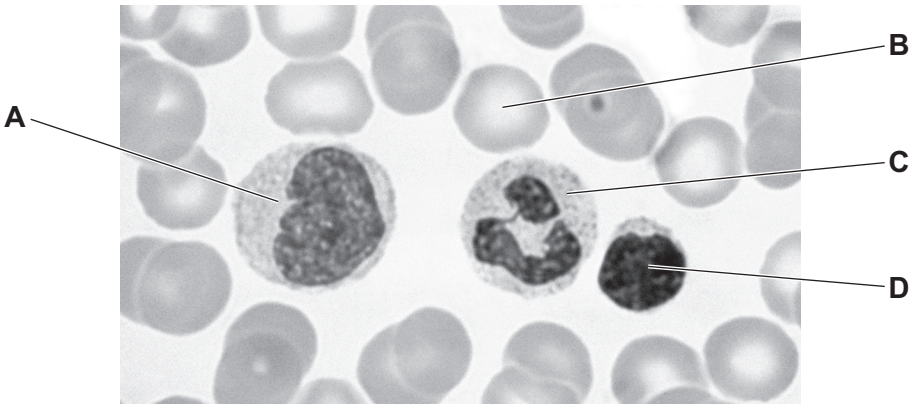
C providing the nucleus for cell division in the phloem

D providing the source of assimilates for storage

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32 The photomicrograph shows a blood smear.

Which cell is a monocyte?



33 The table shows some information about three blood vessels, P, Q and R, from a mammal.

	diameter / mm	wall thickness / mm	percentage composition of wall		
			muscle	collagen	elastic tissue
P	25	2	22	33	40
Q	20	1	25	40	25
R	4	1	35	25	30

Which row identifies blood vessels P, Q and R?

	P	Q	R
A	artery	vein	artery
B	artery	vein	capillary
C	vein	artery	capillary
D	vein	artery	vein

34 Ventricular septal defect (VSD) is a heart defect that people can have from birth. People with VSD have a hole in the wall (septum) that separates the left and right ventricles.

What could happen in a person with VSD?

1 Blood will leak through the hole, mostly from right to left.

2 The volume of blood circulating through the lungs will be higher than in a person without VSD.

3 Less oxygen will be delivered to the body tissues.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

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35 Which statement about the structure of the heart is correct?

A The semilunar valves close when the pressure in the ventricles falls lower than the pressure in the arteries.

B A muscle called the septum separates the atria from the ventricles.

C There is a small patch of tissue in the right atrium that acts to delay the electrical impulse.

D Closure of valves in the veins prevents backflow of blood into the ventricles.

36 What can be found in the wall of an alveolus in the lungs of a human?

	cartilage	cilia	elastic fibres
A	✓	✓	✗
B	✗	✗	✓
C	✓	✗	✗
D	✗	✓	✓

key

✓ = present

✗ = not present

37 What are the functions of cilia in the gas exchange system?

1 to move mucus

2 to trap pathogens and dust

3 to increase the surface area

	1	2	3
A	✓	✗	✗
B	✓	✓	✗
C	✗	✓	✓
D	✗	✗	✓

key

✓ = a function

✗ = not a function

38 Cholera and tuberculosis are infectious diseases that can spread when people have to live in overcrowded conditions.

Which strategies would help control the spread of cholera **and** tuberculosis?

1 covering food to prevent flies landing on it

2 providing chlorinated drinking water

3 treating severe cases with antibiotics

A 1, 2 and 3 **B** 1 only **C** 2 and 3 only **D** 3 only

39 Immunity to certain pathogens develops when a person is given a vaccination.

Which effects of vaccination are correct?

1 production of antibodies to protect against future infections

2 results in artificial active immunity

3 stimulation of appropriate lymphocytes

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

40 A student wrote three statements about antibodies.

1 Their structure depends on peptide, hydrogen and disulfide bonds.

2 They are protein molecules with both tertiary and quaternary structure.

3 Four polypeptides provide four antigen binding sites.

Which statements are correct?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

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BIOLOGY **9700/13**

Paper 1 Multiple Choice **October/November 2022**

1 hour 15 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

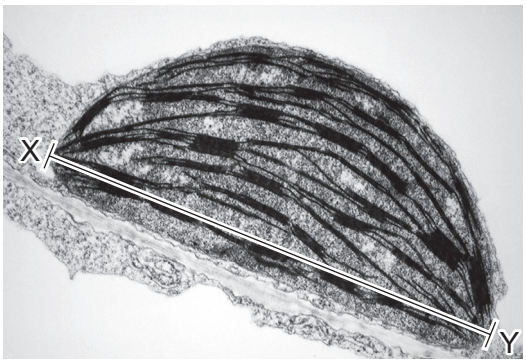
- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.

IB22 11_9700_13/5RP
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1 The electron micrograph shows a chloroplast from a tobacco leaf.



If the actual length of this chloroplast measured along X–Y is 10 μm, what is the magnification of the image?

A ×6.3 **B** ×63 **C** ×630 **D** ×6300

2 Some cell structures are listed.

1 endoplasmic reticulum

2 Golgi body

3 mitochondrion

4 chloroplast

Which cell structures do **not** contain cristae?

A 1, 2, 3 and 4

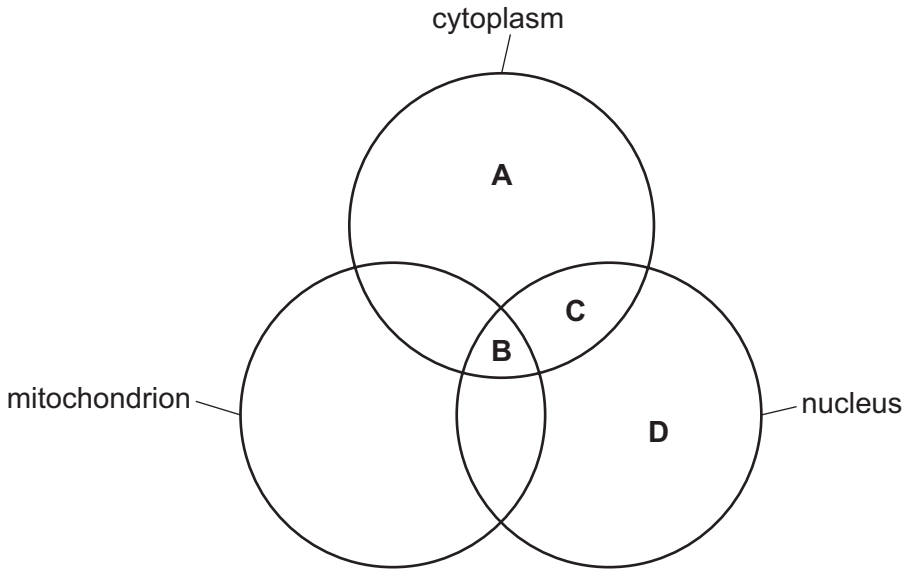
B 1, 2 and 4 only

C 1 and 2 only

D 3 and 4 only

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3 Which letter represents cell structures where mRNA may be found?



4 Which row is correct for typical prokaryotic cells **and** mitochondria?

	feature	prokaryotic cells	mitochondria
A	70S ribosomes	no	yes
B	circular DNA	yes	no
C	peptidoglycans	yes	no
D	small size, 1–5 μm long	no	no

5 Which statement is correct?

A A virus is composed of a protein coat which surrounds RNA or DNA.

B Suberin and cellulose are found in all plant cell walls.

C Plasmodesmata and centrioles are found in all plant cells.

D Prokaryotic cells contain an endoplasmic reticulum to synthesise proteins.

6 The Benedict's test and ethanol emulsion test were carried out on a sample of biological molecules. The solution became brick-red during the Benedict's test and cloudy during the ethanol emulsion test.

Which molecules did the sample contain?

A reducing sugars and lipids

B proteins and reducing sugars only

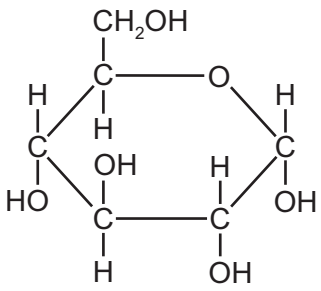
C starch, proteins and reducing sugars

D non-reducing sugars and lipids

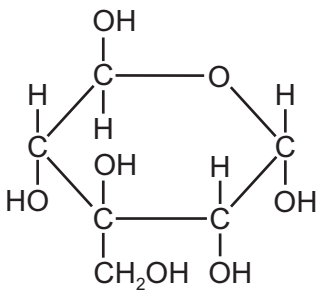
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7 Which diagram is correct for α-glucose?

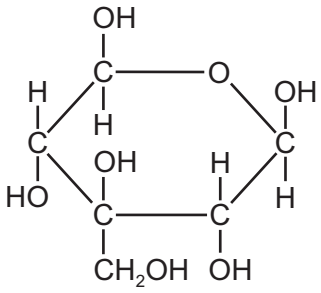
A



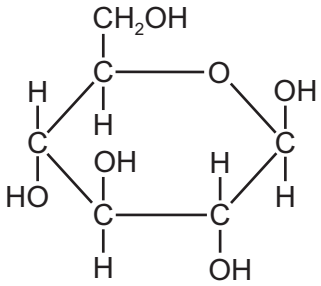
B



C



D



8 Which reaction correctly represents one way sucrose can form?

A (α-glucose – OH^-) + (fructose – H^+) → sucrose + H_2O

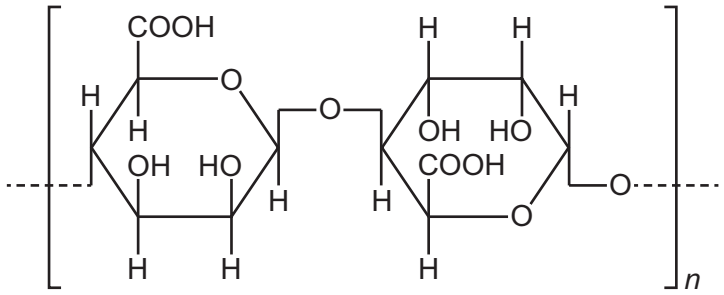
B (α-glucose + OH^-) + (α-glucose + H^+) → sucrose – H_2O

C (α-glucose – OH^-) + (β-glucose – H^+) → sucrose + H_2O

D (α-glucose + OH^-) + (fructose + H^+) → sucrose – H_2O

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9 The diagram represents part of an alginic acid molecule. Alginic acid is a polymer found in the cell walls of brown seaweeds.



Which statement about alginic acid is correct?

A Alginic acid is a linear polysaccharide containing 1,6 glycosidic bonds between each hexose sugar.

B Alginic acid is formed from two monomers joined by 1,4 glycosidic bonds.

C Alternate monosaccharides are arranged in opposite directions; this is also seen in glycogen molecules.

D Hexose sugars and water molecules are joined by condensation reactions to make alginic acid.

10 Which features are correct for triglycerides **and** phospholipids?

1 They have ester bonds between glycerol and fatty acids.

2 Fatty acid chains may have single or double bonds between carbon atoms in the chains.

3 The fatty acid chains are non-polar and hydrophobic.

4 Saturated fatty acid chains allow closer packing of the molecules than unsaturated fatty acid chains.

A 1, 2, 3 and 4

B 1 and 3 only

C 2, 3 and 4 only

D 2 and 4 only

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11 A scientist studying the structure of a protein reported that it consists of two polypeptide chains joined by disulfide bonds.

Which feature of protein structure does this describe?

A primary structure

B secondary structure

C tertiary structure

D quaternary structure

12 Some molecules fluoresce when illuminated with ultraviolet light. Changes in the structure or shape of such molecules can change the intensity of the fluorescence.

The enzyme tryptophan synthase fluoresces bluish-green because of a phosphate group associated with the active site. The enzyme catalyses the reaction shown.

$$\text{serine + indole} \rightarrow \text{tryptophan}$$

Adding serine to the enzyme increases the intensity of the fluorescence, but when indole is also added the bluish-green fluorescence decreases in intensity.

What may be concluded from these observations?

1 Serine and indole attach to the active site of the enzyme.

2 An enzyme–serine complex is formed.

3 An enzyme–serine–indole complex is formed.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

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13 Yeast contains the enzyme catalase which catalyses the breakdown of hydrogen peroxide (H_2O_2) as shown.

$$2H_2O_2 \xrightarrow{\text{catalase}} 2H_2O + O_2$$

Yeast was added to a solution of hydrogen peroxide and the total volume of oxygen released was recorded every 30 seconds for 2 minutes. All other variables were standardised.

The data is shown in the table.

time / s	total volume of O_2 / cm^3
30	157
60	251
90	283
120	285

What explains the pattern of the data?

A The rate of reaction increases as more enzyme–substrate complexes are formed.

B The rate of reaction increases as the enzyme reaches its maximum velocity (V_{max}).

C The volume of oxygen released decreases as the enzymes begin to denature.

D The volume of oxygen released decreases as more substrate is converted into product.

14 The Michaelis–Menten constant, K_m, is a measure of the affinity of an enzyme for its substrate.

1 The higher the affinity, the lower the K_m.

2 The lower the affinity, the slower the reaction will be.

3 At K_m, half the active sites of the enzyme are occupied by the substrate.

Which statements about K_m are correct?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

15 Which features are correct for active transport **and** facilitated diffusion?

1 The movement of molecules and ions depends on ATP.

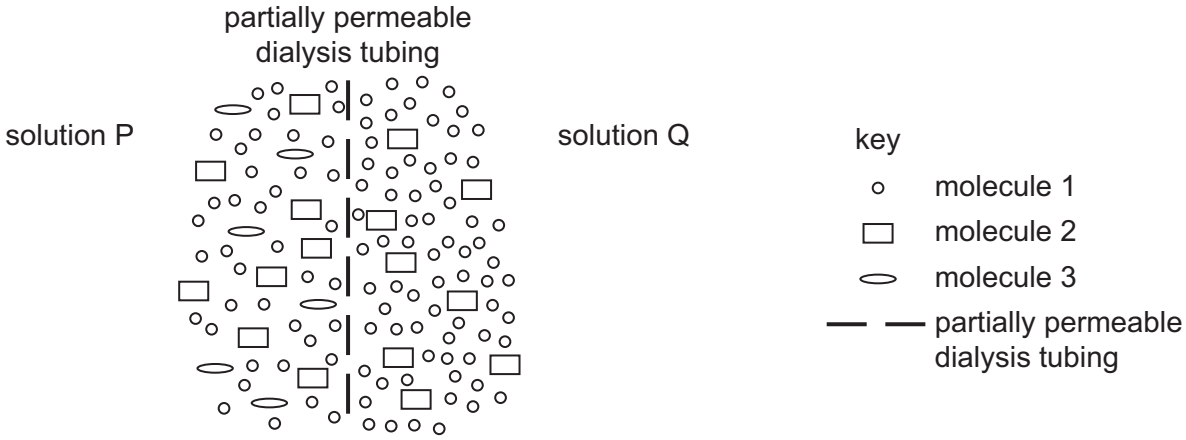
2 They are specific for one type of molecule or ion.

3 They use membrane proteins.

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 only

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16 The diagram represents two solutions, P and Q, that were separated by a partially permeable dialysis tubing.



What will be the initial movement of the molecules, 1, 2 and 3, between solution P and solution Q?

	net movement from Q to P	net movement from P to Q	no net movement
A	molecule 1	molecule 2	molecule 3
B	molecule 1	molecule 3	molecule 2
C	molecule 2	molecule 3	molecule 1
D	molecule 3	molecule 1	molecule 2

17 A student weighed a cylinder of potato and then put it into a test-tube containing a salt solution.

The potato cylinder was removed from the salt solution after one hour. It was blotted dry and then reweighed. The student recorded that the potato had lost mass.

Which row shows the correct explanation for the results the student collected?

	water potential of the potato cells before soaking compared to the water potential after soaking	condition of the potato cells after soaking
A	higher	plasmolysed
B	higher	turgid
C	lower	plasmolysed
D	lower	turgid

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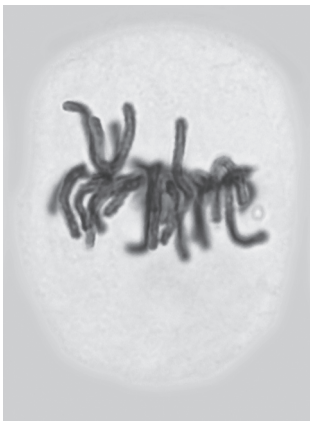
18 Which row shows the correct number of each component in a single chromosome at the start of telophase of mitosis?

	centromeres	polynucleotide strands	telomeres
A	1	2	2
B	1	4	4
C	2	4	2
D	2	2	4

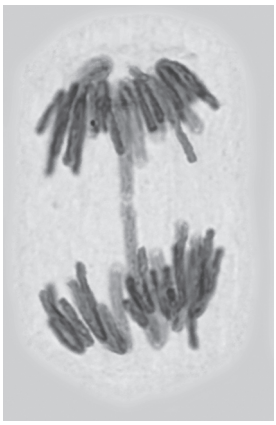
19 The photomicrographs show cells in various stages of the cell cycle.

In which stage does semi-conservative replication of DNA take place?

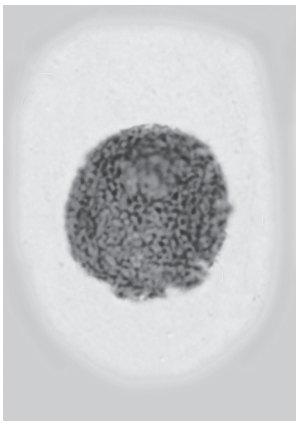
A



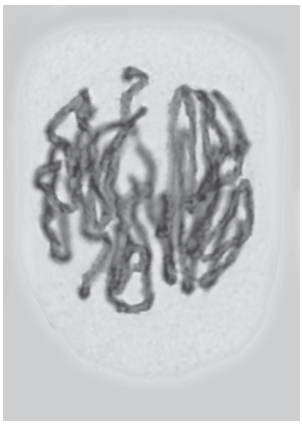
B



C

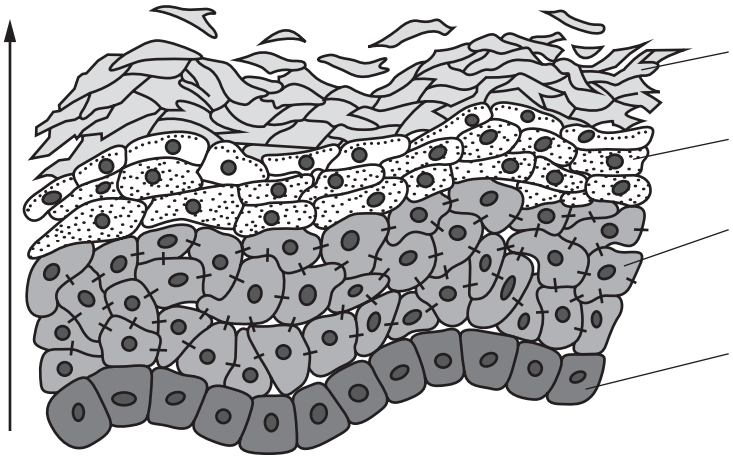


D



20 The diagram shows the epidermis of human skin. This is formed of four layers of cells.

Cells in each layer have specific functions which are outlined on the diagram. As the cells are produced, they move upwards as shown by the arrow.

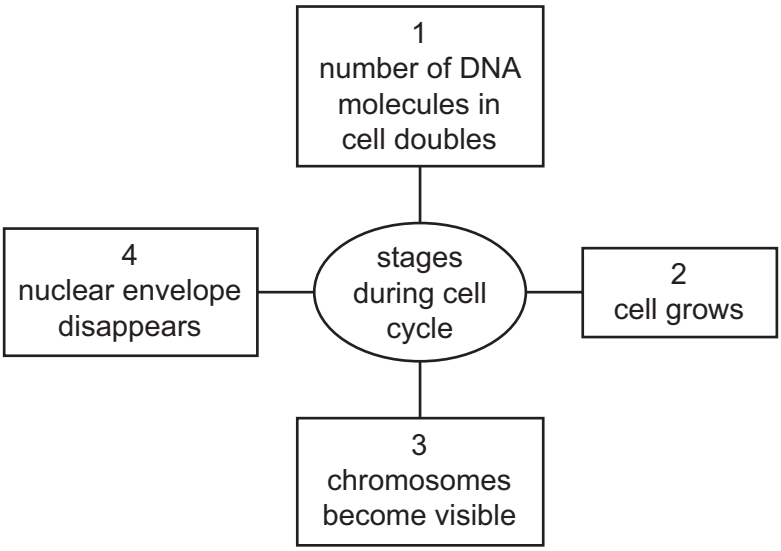


Which row shows cells that are acting as stem cells in the skin epidermis and an organelle needed by the keratinocytes?

	cells that are acting as stem cells	organelle needed by the keratinocytes
A	basal cells only	centrioles
B	basal cells only	Golgi body
C	basal cells and keratinocytes	centrioles
D	basal cells and keratinocytes	Golgi body

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21 The diagram shows some of the stages that take place during the cell cycle.



Which two stages take place during interphase?

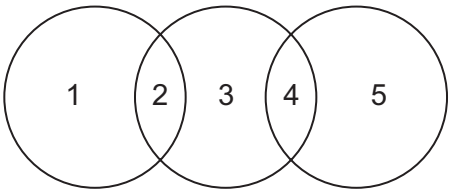
A 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 3 and 4

22 What does a nucleotide contain?

1 an amino acid
2 a codon
3 a nitrogenous base
4 a sugar

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

23 A diagram can be used to show some relationships between different nucleic acid bases.



Which row is correct for the words that can be placed at positions 1–5?

	1	2	3	4	5
A	adenine	purine	cytosine	pairs with	guanine
B	cytosine	purine	guanine	pairs with	uracil
C	guanine	pairs with	cytosine	pyrimidine	thymine
D	thymine	pairs with	uracil	pyrimidine	adenine

24 The bacterium *Escherichia coli* divides once every 50 minutes at 36 °C.

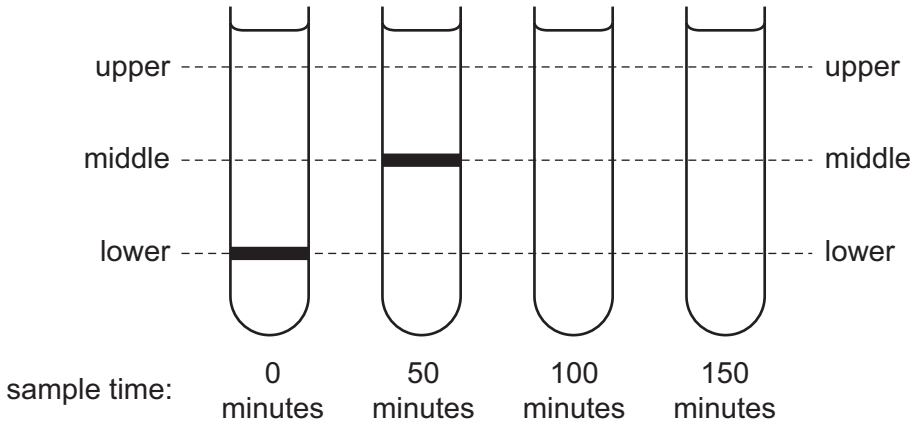
E. coli were grown on a medium containing only heavy nitrogen, ^{15}N, until all of the bacterial DNA contained heavy nitrogen.

Some of the bacteria were moved from a heavy nitrogen medium and cultured in a medium with only light nitrogen, ^{14}N (0 minutes).

These bacteria continued to reproduce and samples were extracted and centrifuged at regular intervals.

Hybrid DNA contains both heavy and light nitrogen.

The diagram shows the possible positions (upper, middle and lower) of the bands of DNA. The actual positions of bands in the first two samples are shown.



Which proportion of the DNA of the sample taken at 150 minutes will be at the upper position?

A 25% **B** 50% **C** 75% **D** 100%

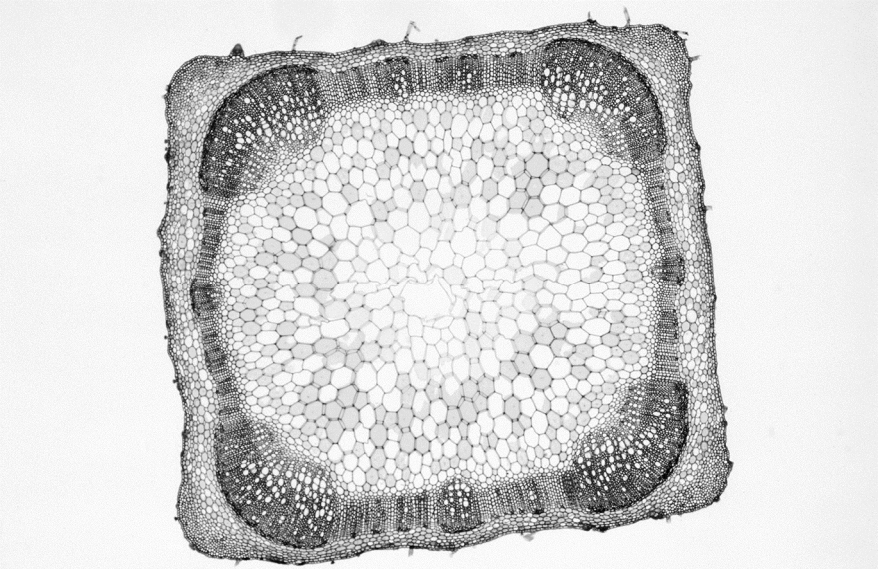
25 Following translation, the alpha polypeptide chain of haemoglobin, α-globin, undergoes modification. During this modification, the first amino acid is removed, leaving 141 amino acid residues.

How many nucleotides does the mRNA coding for α-globin contain?

A 141 **B** 142 **C** 423 **D** 426

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26 The photomicrograph shows a section through a plant organ.



Which statement could be used to describe this organ?

A The central region of this organ has supporting tissue.

B The endodermis tissue is a thick layer around the edge of the organ.

C The epidermis tissue in this organ has extensions (trichomes).

D The xylem tissue is found in greatest density in the centre of the organ.

27 The statements describe some of the properties of water.

1 requires a lot of heat energy to evaporate

2 retains a lot of heat energy

3 is able to form hydrogen bonds with other water molecules

4 is able to form hydrogen bonds with other polar and non-polar molecules

Which properties are **also** important for transport in xylem?

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1 and 3 only **D** 3 and 4

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28 Which xerophytic adaptations reduce the water potential gradient between leaf surface and atmosphere?

1 rolled leaves

2 hairy leaves

3 sunken stomata

4 fewer stomata

5 fleshy leaves

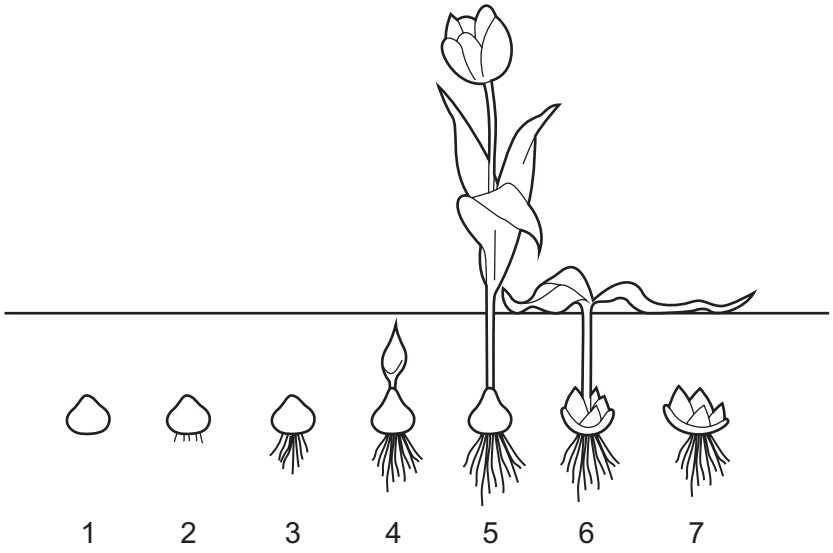
A 1, 2, 3, 4 and 5

B 1, 2 and 3 only

C 1, 3 and 4 only

D 2 and 5 only

29 The diagram shows seven stages of a tulip bulb's growth.



Which row identifies the correct stages in which the tulip bulb is acting as a source only or as a sink only?

	source only	sink only
A	1	5
B	3	4
C	4	6
D	5	7

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30 What would be changed if mitochondrial activity was inhibited by a metabolic poison acting on cells in the phloem tissue?

1 concentration of hydrogen ions in the cell wall of companion cells

2 concentration of sucrose in the cytoplasm of cells in a leaf

3 hydrostatic pressure gradient in the phloem sieve tube

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

31 By which process does sucrose move through phloem sieve tube elements?

A active transport

B diffusion

C facilitated diffusion

D mass flow

32 Which blood vessels carry blood into the atria?

1 coronary artery

2 vena cava

3 pulmonary artery

4 pulmonary vein

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 2 and 4

33 Which statements about the cardiac cycle are correct?

1 The atrioventricular valves close during atrial systole.

2 The left and right ventricles contract together.

3 There is a time delay as the electrical impulse passes from the atrioventricular node to the sinoatrial node.

4 Electrical impulses pass along the Purkyne tissue to the ventricles.

A 1, 2 and 3 **B** 1, 3 and 4 **C** 2 and 4 **D** 3 and 4 only

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34 At one point in the cardiac cycle, the pressure in the right ventricle is lower than that in the right atrium and lower than that in the pulmonary artery.

Which row is correct?

	atrioventricular valve	semilunar valve
A	closed	closed
B	closed	open
C	open	closed
D	open	open

35 Which statements about the formation of haemoglobinic acid are correct?

1 It is linked to the action of carbonic anhydrase.

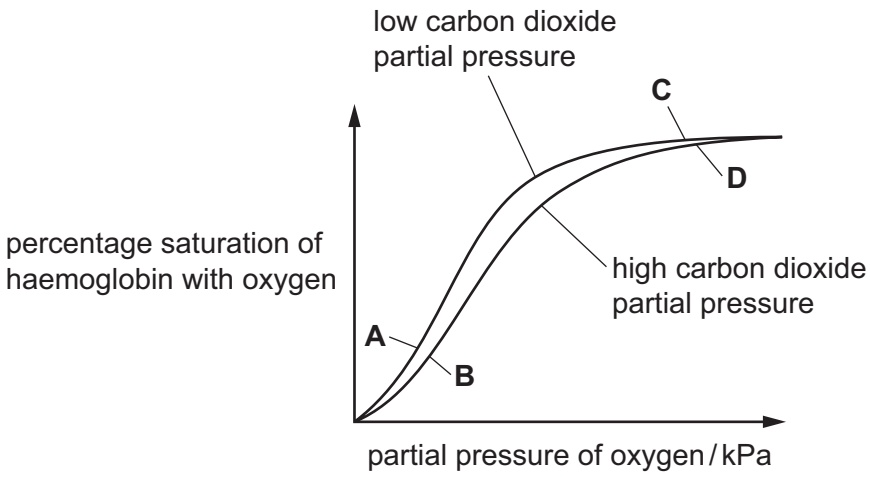
2 It prevents blood from becoming too acidic by removing excess hydrogen ions.

3 It can only occur when oxygen associates with haemoglobin.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 only **D** 2 and 3 only

36 The graph shows the dissociation curves for haemoglobin at two different partial pressures of carbon dioxide.

At which position on the graph would most chloride ions be found in the red blood cells?



37 Oedema is caused by the accumulation of tissue fluid around body cells.

What would increase the amount of tissue fluid around body cells?

A lower blood pressure than normal

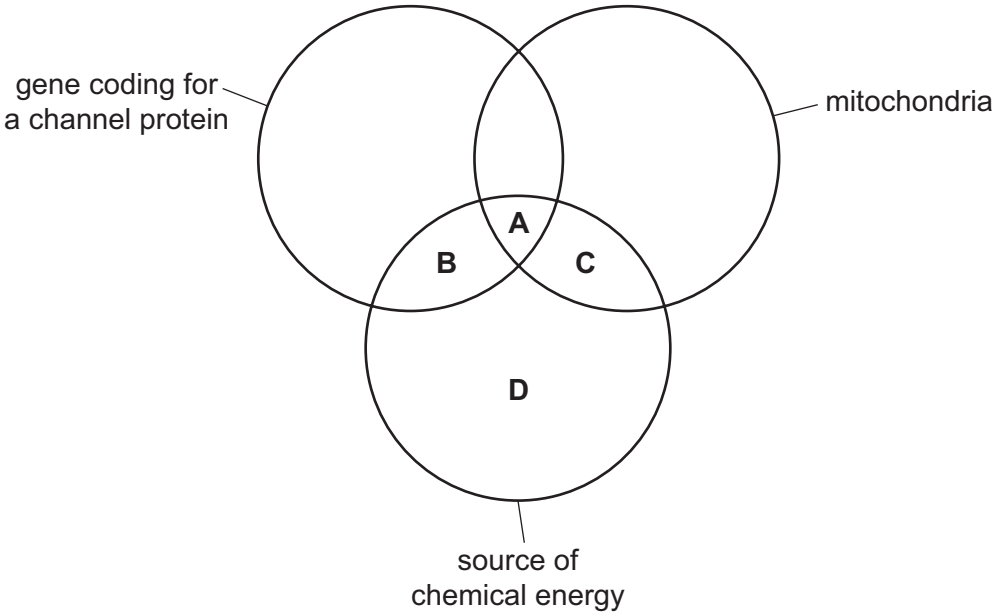
B lower blood plasma protein concentration than normal

C higher blood plasma protein concentration than normal

D lower tissue fluid protein concentration than normal

38 Certain bacteria develop resistance to an antibiotic by actively transporting the antibiotic out of the cell. This prevents the antibiotic building up to toxic concentrations.

What must be found in a bacterial cell to allow it to develop this form of antibiotic resistance?



39 Which statements explain the differences between a primary and a secondary response to exposure to the same antigen?

1 The primary response is slow, because there are only a few B-lymphocytes that are specific to the antigen.

2 The secondary response is faster, because there are many memory cells specific to the antigen.

3 More antibodies are produced during the secondary response, because many of the memory cells differentiate into plasma cells specific to the antigen.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

40 Which statement about B-lymphocytes **and** T-lymphocytes is correct?

A They become active only when a specific antibody binds to their surface receptor.

B They divide to form clones when meeting an antitoxin in a cell.

C They produce memory cells to respond to an antigen when exposed in the future.

D They release hormone-like cytokines which stimulate release of antibodies.

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